

CLAIMS

1. A safe movement support apparatus, comprising:
an environmental three-dimensional information
5 acquisition unit for acquiring environmental
three-dimensional information corresponding to a state
of actual object within a virtual space surrounding a
moving body or an assumed movement track relating the
moving body with a prescribed finite expanse;
10 a moving body state information acquisition unit
for acquiring moving body state information relating
to the moving body; and
a safe movement-enabled space calculation unit for
calculating a safe movement-enabled space which is a
15 virtual space with a finite expanse in which the moving
body is presumed to be movable safely, based on the
environmental three-dimensional information obtained
from the environmental three-dimensional information
acquisition unit and moving body state information
20 obtained from the moving body state information
acquisition unit.
2. A safe movement support apparatus, comprising:
an environmental three-dimensional information
25 acquisition unit for acquiring environmental

three-dimensional information corresponding to a state of actual object within a virtual space surrounding a moving body or an assumed movement track relating the moving body with a prescribed finite expanse;

5 a texture acquisition unit for acquiring a texture relating to the virtual space;

 a moving body state information acquisition unit for acquiring moving body state information relating to a state of the moving body; and

10 a safe movement-enabled space calculation unit for calculating a safe movement-enabled space which is a virtual space with a finite expanse in which the moving body is presumed to be movable safely, based on environmental three dimensional information obtained from the environmental three-dimensional information acquisition unit, moving body state information obtained from the moving body state information acquisition unit and a texture obtained from the texture acquisition unit.

20 3. A safe movement support apparatus, comprising:
 an environmental three-dimensional information acquisition unit for acquiring environmental three-dimensional information corresponding to a state of actual object within a virtual space surrounding a
25 moving body or an assumed movement track relating the

moving body with a prescribed finite expanse;

a texture acquisition unit for acquiring a texture relating to the virtual space;

5 a moving body state information acquisition unit for acquiring moving body state information relating to a state of the moving body;

10 a safe movement-enabled space calculation unit for calculating a safe movement-enabled space which is a virtual space with a finite expanse in which the moving body is presumed to be movable safely, based on environmental three dimensional information obtained from the environmental three-dimensional information acquisition unit, moving body state information obtained from the moving body state information acquisition unit and a texture obtained from the texture acquisition unit;
15 and

a stable movement path calculation unit for calculating a path on which the moving body is presumed to be movable stably based on the information indicating
20 a safe movement-enabled space obtained from the safe movement-enabled space calculation unit and moving body state information obtained from the moving body state information acquisition unit.

25 4. The safe movement support apparatus according to

claim 3, further comprising

5 a moving body control unit for controlling so as to enable the moving body to move along a path on which the moving body is presumed to be stably movable and that has been calculated by the stable movement path calculation unit.

5. The safe movement support apparatus according to claim 2, wherein

10 the texture acquisition unit is configured to acquire plural pieces of data indicating textures in a time series.

6. The safe movement support apparatus according to claim 2, wherein

15 the texture acquisition unit is configured to acquire a texture by using either one or plurality of devices such as a visible light imaging device, infrared light imaging device, high sensitivity imaging device, or high dynamic range imaging device.

7. The safe movement support apparatus according to claim 1, wherein

25 the environmental three-dimensional information acquisition unit is configured to acquire plural pieces

of environmental three-dimensional information in a time series.

8. The safe movement support apparatus according to
5 claim 1, wherein

the environmental three-dimensional information
acquisition unit is configured to acquire the
environmental three-dimensional information by using
either one or plurality of systems such as a Time of
10 Flight system, system utilizing a stereo camera, system
by a Shape From Motion, system by a pattern projection
method, or system utilizing GPS and map information.

9. The safe movement support apparatus according to
15 claim 1, wherein

the moving body state information acquisition unit
is configured to acquire plural pieces of the moving
body state information in a time series.

20 10. The safe movement support apparatus according to
claim 1, wherein

the moving body state information acquisition
unit is configured to acquire the moving body state
information relating to either one or plurality of
25 information, such as a position & attitude, speed,

angular speed, strain of body, steering angle, acceleration, angular acceleration, driving power, braking power, gear ratio of driving power transmission system, environmental temperature and humidity,
5 remaining fuel quantity, remaining battery capacity, maximum torque, vehicle size and weight, presence or absence of special function, and minimum turning radius, about the moving body.

10 11. The safe movement support apparatus according to claim 1, wherein

the safe movement-enabled space calculation unit comprises either one or plurality of units such as the one for calculating a movement-enabled plane, which is
15 a projection to a prescribed plane, of region in which the moving body is enabled to move, the one for calculating a state on the movement-enabled plane, the one for calculating a region allowing the moving body to exist from among the movement-enabled plane, or the one for
20 predicting a transition in time with regard to at least either one among the movement-enabled plane, a state on the movement-enabled plane and a region allowing the moving body to exist within the movement-enabled plane.

25 12. The safe movement support apparatus according to

claim 1, wherein

a vehicle is applicable to the moving body.

13. The safe movement support apparatus according to
5 claim 1, wherein

either one or plurality among the environmental
three-dimensional information acquisition unit, moving
body state information acquisition unit and safe
movement-enabled space calculation unit are equipped
10 on the outside of the moving body.

14. The safe movement support apparatus according to
claim 2, wherein

either one or plurality among the environmental
15 three-dimensional information acquisition unit,
texture acquisition unit, moving body state information
acquisition unit and safe movement-enabled space
calculation unit are equipped in the outside of the moving
body.

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15. The safe movement support apparatus according to
claim 3, wherein

either one or plurality among the environmental
three-dimensional information acquisition unit,
25 texture acquisition unit, moving body state information

acquisition unit, safe movement-enabled space calculation unit and stable movement path calculation unit are equipped in the outside of the moving body.

5 16. A safe movement support method, comprising the processes of

 obtaining environmental three-dimensional
information corresponding to a state of actual object
within a virtual space surrounding a moving body or an
10 assumed movement track relating the moving body with
a prescribed finite expanse and moving body state
information relating to a state of the moving body; and
 calculating a safe movement-enabled space which
is a virtual space with a finite expanse in which the
15 moving body is presumed to be safely movable, based on
the environmental three dimensional information and
moving body state information.

20 17. A safe movement support method, comprising the processes of

 obtaining environmental three-dimensional
information corresponding to a state of actual object
within a virtual space surrounding a moving body or an
assumed movement track relating the moving body with
25 a prescribed finite expanse, a texture relating to the

virtual space, and moving body state information relating to a state of the moving body; and

5 calculating a safe movement-enabled space which is a virtual space with a finite expanse in which the moving body is presumed to be movable safely, based on the environmental three dimensional information, moving body state information and texture.

10 18. A safe movement support method, comprising the processes of

obtaining environmental three-dimensional information corresponding to a state of actual object within a virtual space surrounding a moving body or an assumed movement track relating the moving body with a prescribed finite expanse, a texture relating to the virtual space, and moving body state information relating to a state of the moving body;

20 calculating a safe movement-enabled space which is a virtual space with a finite expanse in which the moving body is presumed to be safely movable, based on the environmental three dimensional information, moving body state information and texture; and

25 calculating a path on which the moving body is presumed to be stably movable based on the information indicating a safe movement-enabled space and moving body

state information.

19. The safemovement support method according to claim
18, further comprising the process of controlling so
5 as to enable the moving body to move along the path.